Diversity, distribution and utilization of fodder species in sub-temperate, temperate and cold desert region of the Himachal Pradesh, north-western, Himalaya

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Abstract: Agriculture with animal husbandry is prevalent profession of rural people of Indian Himalayan Region. Livestock is considered one of the main sources of livelihood and integral part of livelihood, which rely mostly on fodder extracted from forests, grasslands, agriculture and agroforestry. The diversity, distribution and utilization pattern of the fodder species is important to prioritization of fodder species along an altitudinal gradient, and conservation and management practices of fodder species in both the Kullu and Lahaul valleys. Out of 67 fodder species, 43.28% were trees, 26.87% small trees and 29.85% shrubs, respectively. In general, maximum species were lopped annually, except *Olea ferruginea, Quercus floribunda, Q. leucotrichophora* and *Salix fragilis,* which were lopped an interval of 3 years. Majority of the fodder species are used as multipurpose and contributed to the high socioeconomic values. [Journal of American Science 2010;6(6):72-81]. (ISSN: 1545-1003).

Keywords: Diversity; agroforestry; fodder; utilization; conservation and management; north-western Himalaya

1. Introduction

In the north-western Himalaya, farmers maintain naturally regenerating tree species, particularly on edges of terraced agriculture fields without any significant input of manpower. This system is called as indigenous agroforestry system (Ram and Singh, 1996; Vishvakarma et al., 1998). The indigenous agroforestry system is a model of ex-situ and in-situ conservation that reduces the pressure from forest resources in terms of fodder and fuelwood along with site improvement (Ram and Ramakrishnan, 1988; Pathak, 1991; Maikhuri and Semwal, 1997). Tree fodder is valuable for temperate climate (Singh and Kanstra, 1981; Roder, 1992), particularly during winter months when green fodder becomes scarcely available in quantity (Khanal and Subba, 2001; Subba et al., 1994) and quality (Vishvakarma et al., 1998, Roder et al., 2003). Nearly 279 fodder species has been reported from the West Himalaya (Samant, 1998), which have been used to feed the livestock. The livestock is the integral part of the rural people of mountains. The major portion of fodder comes from forests, though some requirements of fodder are also met from grassland, agriculture and agroforestry systems (Purohit and Samant, 1995; Singh et al., 1998). The poor quality of fodder is inadequate to maintain the body weight of livestock (Roder, 1992).

Several tree species are used for fodder purposes in both the Kullu and Lahaul valleys. *Grewia oppositifolia, Robinia pseudoacacia, Morus serrata, Bauhinia variegata, Quercus leucotrichophora, Olea ferruginea, Pyrus pashia, Celtis australis* are common species in indigenous agroforestry system in the Kullu valley (Vishvakarma et al., 1998), and *Salix fragilis, S. alba* tree (Rawat et al., 2006) and shrubs such as *Fraxinus xanthoxyloides, Prunus cornuta, P. prostrata,* particularly in the lower parts of the Lahaul valley are important fodder species. The present study deals with diversity, distribution and utilization pattern of fodder species.

2. Material and Methods

Study area

The Kullu valley starts from Larji (957 m) in south and extends towards north direction along river Beas up to Rohtang pass (3978 m). This valley is about 80 km long and maximum 3 km wide near Bajaura. In the north Pir-Panjal ranges demarcates it from cold desert of the Lahaul-Spiti. Agricultural zone in the valley falls in between 957 to 2200 m. The cold desert of the Lahaul-Spiti district extends between 31°44’34” N & 32°59’57” N latitude and 76°46’29” E & 78°41’34” E longitude. The Great Himalayan range in the north and the Pir Panjal range of the Lesser Himalaya in the south demarcated the northern and southern boundaries of the Lahaul valley. The valley is accessible only during summers after clearing of snow from the Rohtang Pass. The Lahaul valley extends from Khoksar in the southeast direction to Tindi, near Udaipur town, in the

northwest direction. The elevation of this geographical entity ranged between 2400 to 6400 m above mean sea level. Agriculture in the valley is done on terraced fields. In large parts of the valley, willow and occasionally poplar trees were cultivated along the margins of the terraces under the indigenous agroforestry system.

Climate

The Kullu valley receives 112.5 cm annual average rainfall, which is fairly distributed throughout the year. From December to March mercury dips below freezing point during night and in these months, the valley experiences snowfall; the higher reaches of the valley have deposits of fairly good amount of snow. Average snowfall is ~68 cm in the valley region. Maximum temperature ranges from 0.9°C in January to 18.1°C in July (Figure 1a). On the whole, Kullu valley represents mid-hills and sub-humid sub-temperate (915 to 1523 m) and high hills with temperate wet (1524 m to 2472 m) agro-climatic conditions of the northwestern Himalaya.

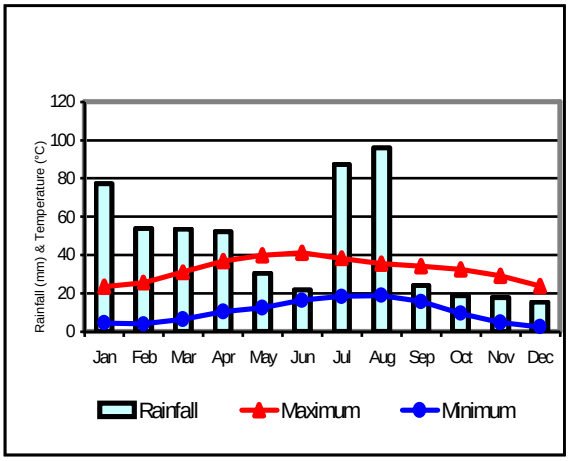

Figure 1a. Climate of the Kullu valley

Climatically, the Lahaul valley comes under cold arid zone with a very low rainfall and high snowfall, severe and prolonged winters. The region remains cut-off by high mountain ranges after heavy snowfall. The valley receives an average of 25 mm rainfall between June and July, and 3000 mm snowfall from November to May (Figure 1b). The valley has extremely harsh climatic conditions. The formation of soil in the region is sandy, alluvial and podsolic soils in the Kullu valley and sandy loam and moraine in nature in the Lahaul valley.

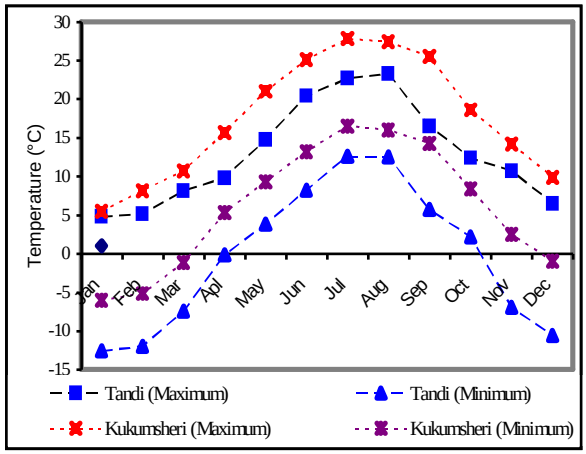

Figure 1b. Climate of the cold desert of the Lahaul valley

Study, data collection and analysis

The five indigenous agroforestry systems were selected for present study namely, Khokhan (1300 m), Bhosh (1700 m) and Bhanara (2020 m) in the Kullu valley, and Hinsa (2700 m) and Jahlma (3000 m) in cold desert of the Lahaul valley. The present study is based on the extensive and intensive surveys conducted in the representative parts of the Kullu and Lahaul valleys for documentation of all the fodder species found in Kullu and Lahaul valleys. The information on local names, altitudinal range, feeding season, life form and other uses was gathered with interviews held with local knowledgeable people (male and female). The collected bundles of fodder species were observed and species were identified with the help of local flora (Aswal and Mehrotra, 1994; Dhaliwal and Sharma, 1999). Fodder collection sites were also visited along with villagers during collection of fodder to identify the fodder species. The Nativity of the species was identified following Anonymous (1883-1970) and Samant (1998). Surveys were also carried out for seasonal lopping and utilization pattern of each species on the monthly basis. Species wise seasonal utilization pattern of fodder and mode of use (green and dry) were studied through direct observation.

3. Results and Discussion

Village systems

The altitudinal zonation of present study villages varied from 1300 m to 2020 m in the Kullu valley and 2700 m to 3000 m in cold desert of the Lahaul valleys (Table 1). The revenue areas under Bhosh and Hinsa villages were more or less equal about 33 to 34 ha, whereas, largest village in the area was Jahlma followed by Khokhan in Kullu valley.

The revenue of Bhanara was relatively smaller as compared to other villages. Number of households in the study villages were highest in Khokhan followed by Hinsa and lowest number of household were in Bhosh village.

Table 1. Location, revenue area, numbers of households and population of study villages in the Kullu and Lahaul valleys

	Village	Altitude (m)	Geographical locations		Area (ha)	House holds	Population (Person)	Land holding (ha/capita)
			Latitude	Longitude				
Kullu	Khokhan	1300	31°52 ’676 N	37°7’ 956 E	52.26	101	611	0.09
	Bhosh	1700	32°08 ’133 N	77°10’ 568 E	34.46	35	272	0.13
	Bhanara	2020	32°12 ’173 N	77°12 ’395 E	23.14	38	244	0.09
Lahaul	Hinsa	2700	32°41 ’367 N	76° 41’ 167E	33.28	52	386	0.09
	Jahlma	3000	32°38 ’226 N	76°52’ 009 E	58.27	41	479	0.12
	Total	-	-	-	-	267	1992	

Livestock

Agriculture with animal husbandry is prime occupation of native communities living in rural areas of the Kullu and Lahaul valleys. The oxen were reared for drought power for land tilling; however, yak was used for breeding purposes or transportation in the inaccessible areas (Singh et al., 1997). Cattle like jersey cow, desi cow, yak breeds, horse and ponies, mule, sheep and goat were common livestock in the study villages (Figure 2). Desi cow (local breed) is short in size and was lesser in number as compared to Jersey and *Brogar*. *Brogar* is a variety of cow originated after segregation of genes. *Brogar* originates after cross between jersey bull and desi cow.

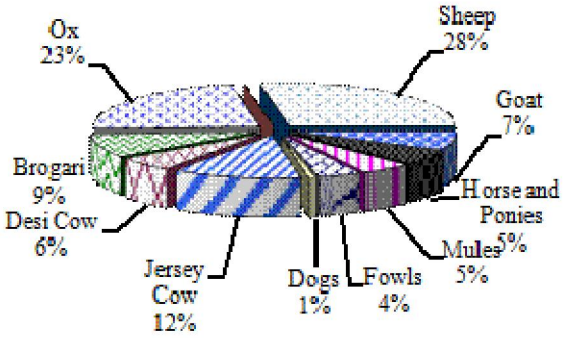

Figure 2. Composition of livestock in the study villages of the Kullu and Lahaul valleys

Brogar is slightly larger than desi cow and smaller than hybrid Jersey cow. Maximum number of *Brogar* was found in Khokhan followed by Bhanara village. Churi, a hybrid of yak and desi cow was fading in number due to introduction of Jersey cow in the Lahaul valley. Churies were nearly in half number of the desi cows. Oxen were relatively higher in number as compared to desi cow and churi. Sheep and goat were kept basically for wool and meat purposes in all the villages. These animals are supporting the livelihood and economy of the rural villages. In the entire Himachal as well as in Kullu valley, desi cow are being gradually replaced by Jersey cow due to their ability of higher milk production (Vishvakarma et al., 1998). Similar trend was found in cold desert of the Lahaul valley (Rawat et al., 2006).

Diversity, distribution, nativity and uses

An inventory of plant species of five indigenous agroforestry systems was prepared (Table 2). The distribution of fodder species along an altitudinal gradient ranged between 900-3800 m. The trees included deciduous and evergreen species and most of the fodder species are native to the Himalayan region and neighbouring countries. Out of 67 fodder species, 43.28% were trees, 26.87% small trees and 29.85% shrubs. Indigenous agroforestry system of Khokhan was dominated by *G. oppositifolia*. However, *Q. floribunda* was dominant species at Bhosh and Bhanara villages. The important fodder species in the Lahaul valley were *S. fragilis, Hippophae rhamnoides, Juglans regia, Populus nigra, P. armeniaca, P. cornuta* and *P. communis*. *S. fragilis* was a major contributor of fuelwood and fodder in cold desert of the Lahaul valley. *M. serrata, R. pseudoacasia* and *S. wallichiana* were common species found in all the three villages of Kullu valley, whereas, *S. fragilis, F. xanthoxyloides* and *P. cornuta* were common species at both villages of the Lahaul valley.

There was not any special tree plantation in the Kullu valley, exclusively for fuelwood and fodder purposes. However, in the Lahaul valley willow plantations are along the agroforestry and wasteland. Law established by the Department of Forest, Govt. of Himachal Pradesh, allow farmers for raising plantation on forest land with an aim to create greenery in the cold deserts. The farmers can use the produce of the plantation but ownership of the land will remains with department of Forest (Pandey, 1993-94 to 2006-07). However, such forest law does not bless people of the Kullu valley.

Utilization pattern

The utilization patterns of fodder species varied from season to season and from lower to higher elevations. The variation in utilization pattern is due to the availability of species in respective seasons. The most of the fodder species were used in summer due to availability of deciduous species; however, the availability of fodder was scarce during winter. There was specific seasonal lopping pattern for tree fodder species in the Kullu and Lahaul valleys (Table 3). In general, maximum species were lopped annually, except *O. ferruginea, Q. floribunda, Q. leucotrichophora* and *S. fragilis*, which were lopped an interval of 3 years. Shrubs were lopped on annual basis.

Nutritious tree fodder is important for oxen at time of field preparations, when, agricultural fields are tilled. The nutritive values showed that *C. australis* had 14.0%, crude protein, 50.8% nitrogen free extract and 11.9% crude fibre, G. oppositifolia had crude protein 10.1% nitrogen free extract 54.8%, calcium 4.2% and phosphorous 10.3%, *Q. leucotrichophora* had crude protein 9.5%, crude fibre 31.3% and nitrogen free extract 48.4% (Anonymous, 1970-1997; Purohit and Samant, 1995). The nutritive fodder is required to the animals for growth, maintenance, production and reproduction. It is depend on to intake, chemical composition and digestibility factors (Gutteridge, 1995). Therefore, these species are required priority attention for mass multiplication and conservation (Bisht et al., 1999). *Bombax ceiba, C. australis, Crataegus songarica, Malus baccata, Melia azedarach, P. cornuta, P. prostrata, P. pashia, R. pseudoacacia, S. wallichiana* and *Toona serrata* were used as fresh fodder during summer from June to November in the Kullu and Lahaul valleys (Table 3). Majority of the fodder species are used as multipurpose and contributed to the high socioeconomic values.

Tree species such as *Ficus palmata, M. serrata, Ulmus villosa* and *U. wallichiana*, were used both as fresh and dry in the Kullu valley; similarly *F. xanthoxyloides* is used both fresh and dry in the Lahaul valley (Table 3). Dry leaves of *Aesculus indica* and *Ficus palmata*, and fresh leaves of *G. oppositifolia, O. ferruginea, Pistacia integerrima, Q. floribunda, Q. leucotrichophora* in the Kullu and *S. fragilis, S. acmophylla* in the Lahaul valley were used during winter months from November to March. The bark of *S. fragilis* is peeled out from lopped branches and coppices and given to cattle as green fodder during winters. Shrubs were used as a fodder during summer. Fine twigs of horticultural crops are also used as fodder during winter. However, some farmers do not use apple twigs as fodder with a faith that their cattle may get cold diseases.

The leaves of *A. indica, C. songarica, Ficus palmate, F. xanthoxyloides, M. baccata, P. integerrima, P. prostrata* and *T. serrata* were fed to the sheep and goats, while, fodder obtained from the remaining species were given to all types of livestock. Shrubs like *Cotoneaster bacillaris, C. pruinosus, Prinsepia utilis, Rhamnus triqueter, Ribes grossularia, R. orientale* and *Rosa macrophylla* were also given to sheep and goat.

4. Recommendation and conclusions

1. The study indicated that *M. serrata* and *Q. floribunda* was key species for villages like Bhosh and Bhanara (temperate), where, pressure on forest resources was more due to conversion of grassland and agricultural land for horticulture. *S. fragilis* in the Lahaul valley (cold desert) and *S. wallichiana* in the Kullu valley (sub-temperate) were ecologically suitable species in their respective locality.
2. Studies on population, biomass, and identification of biotechnological measures to improve germination, propagation and dissemination of know-how to the farmers are required. In addition, analysis of nutritive value for fodder species is immediately required for assessment of quality fodder.
3. This study provides comprehensive information on diversity, distribution and utilization pattern of fodder species along an altitudinal gradient. Lopping and seasonal utilization pattern of fodder species is useful in understanding the mode of fodder use and lopping period. Capacity building and skill development of farmers are also required on mass multiplication, pollarding, coppicing, lopping and utilization pattern of fodder species.
4. Protected plantation of potential multipurpose fodder species are needed in wasteland, and need to initiate programme like afforestation, reforestation and forest rehabilitation with participatory approaches.

Table 2. Important plant species found under indigenous agroforestry systems of the Kullu and Lahaul valleys

S. No.	Name of species	Local name	Khokhan (1300 m)	Bhosh (1700 m)	Bhanara (2020 m)	Hinsa (2700 m)	Jahlma (3000 m)	Uses	Nativity	Altitude (m)
A. Trees										
1	*Abies pindrow* Royle	Rai	—	—	++	++	—	Fl., Ti.	Re. Himal.	2100-3500
2	*Aesculus indica* (Wall. ex Camb.) Hook.	Khanor	—	—	++	—	—	Fl., Fd., Med., Ed.	Reg. Himal.	1700-2500
3	*Alnus nitida* Endl.	Kosh	++	++	++	—	—	Fl, Ti., Agr. Imp., NF.	Reg. Himal.	1000-3000
4	*Bombax ceiba* L.	Semal	++	—	—	—	—	Fl., Fd., Med., Ed.	Am. Austr.	1200-2600
5	*Cedrus deodara* Don	Devdar	—	++	++	—	—	Fl., Ti.	Reg. Himal.	1800-3000
6	*Celtis australis* L.	Kharak	++	++	++	—	—	Fl., Fd., Ed.	Eu. As. Temp. Ind. Or.	800-2000
7	*Dalbergia sisoo* Rox	Shisham	++	—	—	—	—	Fl., Ti, NF	Ind. Or. Afghan.	900-1800
8	*Grewia oppositifolia* Roxb.	Beul	++	—	—	—	—	Fl., Fd., Fib., Ed.	Reg. Himal.	800-2000
9	*Juglans regia* L.	Akhrot	++	++	++	++	++	Fr., Ti.	As Occ. Reg. Himal.	1000-3000
10	*Juniperus macropoda* Boiss.	Shur	—	—	—	—	++	Inc., Aes.	Persia, Reg. Himal.	2600-4000
11	*Malus baccata* (L.) Borkh.	Lijo	—	—	—	++	++	Fl., Fd., Ed.	Reg. Himal. As Bor.	2400-3000
12	*Melia azedarach* L.	Drack	++	—	—	—	—	Fl, Fd., Med.	Reg. Himal. (alibicult)	1200-2600
13	*Morus serrata* Roxb.	Toot/Chenw/ Sahtoot	++	++	++	—	—	Fl., Fd., Med., Ed.	Reg. Himal.	1000-2200
14	*Olea ferruginea* Royle	Kahoo	++	—	—	—	—	Fl., Fd., Med.	Reg. Oriens	1200-2500
15	*Pinus wallichiana* A.B. Jackson	Kail	++	—	—	—	—	Fl., Ti.	Reg. Himal.	1700-3000
16	*Pistacia integerrima* (Stewart.)Rech.	Kakar Singi	++	—	—	—	—	Fl., Fd., Med.	China	1200-2500
17	*Populus ciliata* Royl	Poplar	++	++	++	—	—	Fl., Ti.	Reg. Himal. Illus	1800-3000
18	*Populus nigra* L.	Poplar	—	—	—	++	++	Fl., Ti.	Reg. Himal.	1500-3500
19	*Prunus cornuta* (Wall. ex Royle) Stued	Kurun/Jamu	—	—	++	++	++	Fl., Fd., Ed.	Europe As. Bor.	2400-3300
20	*Quercus floribunda* (Lindl.)	Mor	—	++	++	—	—	Fl., Fd., Ti., Agr. Imp.	Reg. Himal.	1200-3000
21	*Quercus leucotrichophora* A. Camus	Bon	++	++	—	—	—	Fl., Fd., Ti., Agr. Imp.	Reg. Himal.	1200-2500
22	*Robinia pseudoacacia* L.	Kikar	++	++	++	++	++	Fl., Fd., Rec.	Amer. Bor.	800-1500
23	*Salix wallichiana* Anderss.	Buins	++	++	++	—	—	Fl, Fd. Rec.	Reg. Himal.	1200-2000
24	*Salix fragilis* L.	Beli	—	—	—	++	++	Fl., Fd., Tim., Agr. Impl., Rec.	Europe As Bor.	2400-3600
25	*Sapindus mukoro* Gaertn.	Doda	++	—	—	—	—	Fl., Fd., Wa., Cl.	As. Trop.	Upto 1500
26	*Toona serrata* (Roy M. Roem.	Daral	++	++	++	—	—	Fl., Fd., Ti.	Malaya Australia	2000-2800
27	*Ulmus villosa* Brandis	Kashau/Hambe r	—	++	++	—	—	Fl., Fd., Ti.	Europe As Bor.	1200-2500
28	*Ulmus wallichiana* Planch.	Mahun	++	++	++	—	—	Fl, Fd.	Ind. or.	1000-2000
29	*Rhus punjabensis* Stewart ex Brandis	Karvi Copi	—	++	—	—	—	Fl., Med.	Reg. Himal.	1500-2200

B. Small trees										
1	*Citrus limonum* (RISSO)	Nimbu	++	++	—	—	—	Fr.	As Trop.	1000-2000
2	*Crataegus songarica* C.Koch.	Pingyat	—	—	—	++	++	Fl, Fd., Ed., Ti.	Europe as Temp.	2400-3500
3	*Ficus palmata* Forsk.	Phagra	++	++	++	—	—	Fl, Fd., Med., Ed.	Afr. Trop. Arab,; Ind. or.	800-2000
4	*Fraxinus xanthoxyloides* (D.Don) DC.	Chhum/Sanjal	—	—	—	++	++	Fl., Fd., Med. Agr. Imp.	Reg. Himal.	2400-3000
5	*Prunus amygda* Batsch	Badam	—	++	++	—	—	Fr.	Middle East	1500-2200
6	*Prunus armeniaca* L.[1]	Khumani	++	++	++	++	—	Fr.	Reg. Caucas	1500-3000
7	*Prunus armeniaca* L.[2]	Khumani karvi	++	++	++	—	++	Fr.		1500-3000
8	*Prunus avium* L.	Chery	++	++	++	—	++	Fr.	Reg. Himal.	2000-3000
9	*Prunus domestica* L.	Plum	++	++	++	—	++	Fr.	Europe.; Reg. Cauc.	1500-3000
10	*Prunus persica* (L.) Batsch	Aru	++	++	++	—	—	Fr.	Reg. Himal.	1500-3000
11	*Prunus prostrata* Labill.	Ralyo	—	—	—	++	—	Fl., Fd., Ed.	Reg. Mediterri; Oriens	2400-3300
12	*Punica granatum* L.	Anar	++	++	++	—	—	Fr.	Europe austr. Maurit	1000-2000
13	*Pyrus communis* L.	Nashpati	++	++	++	—	—	Fr.	Europe, As. Bor.; Reg. Himal.	1000-2000
14	*Pyrus malus* L.	Seb	++	++	++	++	++	Fr.	Europe, As. Bor.; Reg. Himal.	1300-3000
15	*Pyrus pashia* L.	Segal	++	++	++	—	—	Fl., Fd., Med., Ed.	Reg. Himal.	1000-2000
16	*Salix acmophylla* Boiss.	Jangli Beli	—	—	—	—	++	Fl., Fd.	Oriens; Ind. or	2400-3500
17	*Diospyros kaki* L.	Japani	++	++	++	—	—	Fr.	An. Bor.	1500-2500
18	*Cydonia oblonga* Mill.	Bee Dana	++	++	++	—	—	Fr.	Reg. Mediterr. Et Cauc	1500-2500
C. Shrubs										
1	*Berberis chitria* Lin	Kingor	++	++	++	—	—	Fl., Med., Ed.	Ind. or.	1000-2500
2	*Berberis jaeschkeana* Schneid.	Kyamali	—	—	—	—	++	Fl., Med., Ed.	Reg. Himal.	2400-3800
3	*Berberis pseudumbellata* Parker	Kyamali	—	—	—	++	—	Fl., Med., Ed.	Himal. bor. Occ	2400-3800
4	*Cotoneaster bacillaris* Wall. ex Lindl.	Ruins	++	++	++	—	—	Fl., Fd., Ti.	Reg. Himal.	2400-3800
5	*Cotoneaster pruinosus* Klotz.	Roktali	—	—	—	++	—	Fl., Fd.	Reg. Himal.	2400-3800
6	*Hippophae rhamnoides* L.	Sarla, Chharma	—	—	—	++	++	Fl., Fd., Ti., Med., Rec., Fen.	U.S.S.R, Afghanistan, India, W. Pakistan, Tibet, Mongolia	2400-3800
7	*Indigofera heterantha* Wall. ex Brandis	Kali Kathi	++	++	++	—	—	Fl., Fd.	Reg. Himal.	2400-3800
8	*Juniperus communis* L.var. saxatilis Pallas	Path/Bithar	—	—	—	++	—	Fl., Med.	Reg. Bor. Temp. et arit	2500-3800
9	*Lonicera hypoleuca* Decne.	Kharmu	—	—	—	++	++	Fl., Fd.	Reg. Himal.	2400-3500
10	*Prinsepia utilis* Royle	Bhenkul	++	++	++	—	—	Fl., Fd.	Reg. Himal.	900-2000

11	*Rhamnus triqueter* (Wall. ex Roxb.) Lason	Chamso	++	++	++	––	––	Fl., Fd., Ti.	Reg. Himal.	2400-3500
12	*Ribes alpestre* Decne.	Pilikcha	––	––	––	++	++	Fl., Fd.	Reg. Himal., Euop.; Afr. Bor.;	2400-3500
13	*Ribes orientale* Desf.	-	––	––	––	++	––	Fl., Fd.	Oriens; Reg. Himal.	2400-3500
14	*Rosa webbiana* Wall. ex Royle	Shyabala	––	––	––	++	++	Aes., Fl., Fd.	Reg. Himal.	2200-3500
15	*Rosa macroph* Lindl.	Kuja	++	++	++	––	––	Fl, Fd., Fen.	Reg. Himal., China	900-2200
16	*Rubus ellipticus* Smith	Aachha	++	++	++	––	––	Fl., Ed.	Ind. or.	1200-2200
17	*Salix daphnoides* Vill.	Jangli Beli	––	––	––	++	––	Fl., Fd., Ba.	Europe; As bor.	2400-3600
18	*Syringa emodi* Wall. ex Royle	Pashu	––	––	––	++	––	Fl., Fd.	Reg, Himal.	2400-3300
19	*Zanthoxylum arma* DC.	Timber	++	––	––	––	––	Fl., Med.	Reg. Himal. China	1500-2500
20	*Ziziphus oxyphylla* Edgew.	Ber	++	––	––	––	––	Fl., Ed.	Reg. Himal.	900-2000

1. Wild variety
2. Sweet variety grafted on wild variety
++= Presence of species
––= Absence of species

Abbreviations used: Reg. Himal.=Himalayan Region, Ind Or=Indian Oriental, Bor=Borealis, Temp=Temperate, Arct=Arctic, et=And, As=Asia, Centr=Central, Afr=Africa, Geront=Gerontia, Trop=Tropical, Amphig=Amphigaea, Austr=Australia, Amer=America, N. Zel.= New Zealand, Orient=Oriental, Cosmop=Cosmopolitan, Occ=Occidentalis, Afghan=Afghanistan, Turkist=Turkistan, Arab=Arabia, Subtrop=Subtropical, Hisp=Hispan, Min=Minor, Polynes=Polynesia, Madag=Madagascar, Alger=Algeria

Aes=Aesthetic, Agr. Imp. = Agricultural Implements, Ba. = Basket, Fen. =Fencing, Cl.=Cleaning, Ed.=Edible, Fd.=Fodder, Fl.=Fuel, Fib. =Fiber, Fr.=Fruit, Inc.= Incense, Med.=Medicinal, NF. =Nitrogen Fixing, Rec.= Reclamation, Ti=Timber, Was. =Washing

Table 3. Seasonal lopping period and utilization pattern of important plant species under agroforestry systems of the Kullu and Lahaul valleys

Name of Species	Vernacular name	Mode of use		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
A. Trees		Green	Dry												
1. *Aesculus indica* (Wall. ex Camb.) Hook.	Khanor		D	*	*								√	√	*
2. *Bombax ceiba* L.	Semal	G							√*	√*	√*	√*			
3. *Celtis australis* L.	Kharak	G								√*	√*	√*			
4. *Grewia oppositifolia* Roxb.	Beul	G		√*	√*									√*	√*
5. *Malus baccata* (L.) Borkh.	Lijo	G								√*	√*	√*	√*		
6. *Melia azedarach* L.	Drak	G								√*	√*	√*	√*		
7. *Morus serrata* Roxb.	Sahtoot	G	D	*	*				√*	√*	√*	√*	√*	√*	*
8. *Olea ferruginea* Royle	Kaw	G		√*	√*									√*	√*
9. Pistacia integerrima (Stewart) Rech.	Kakar Singi		D	*	*								√	√	*
10. *Prunus cornuta* (Wall. ex Royle) Stued	Kurun/Jamu	G									√*	√*	√*		

11.	*Quercus floribunda* (Lindl.)	Mor	G		√*	√*	√*								√*	√*
12.	*Quercus leucotrichophora* A. Camus	Bon	G		√*	√*	√*								√*	√*
13.	*Robinia pseudoacacia* L.	Kikar	G					√*	√*	√*	√*	√*	√*	√*		
14.	*Salix fragilis* L.	Beli	G		√*	√*	√*								√*	√*
15.	*Salix wallichiana* Anderss.	Buins	G						√*	√*	√*	√*	√*			
16.	*Toona serrata (Royle)* M. Roem.	Daral	G						√*	√*	√*	√*				
17.	*Ulmus villosa* Brandis	Kashau/Hamber	G	D	*	*					√*	√*	*	*		
18.	*Ulmus wallichiana* Planch	Mahun	G	D	*	*				√*	√*	√*	*	*		
B. Small trees																
1.	*Crataegus songarica* C.Koch.	Pingyat	G						√*	√*	√*	√*				
2.	*Ficus palmata* Forsk.	Phagra		D	*	*	*					√	√	*		
3.	*Fraxinus xanthoxyloides* (D. Don) DC.	Chhum/Sanjal	G	D	*	*	*		√*	√*	√*	√*	*	*		
4.	*Prunus armeniaca* L.[1]	Khumani	G		√*	√*	*							√*		
5.	*Prunus armeniaca* L.[2]	Khumani karvi	G		√*	√*	*							√*		
6.	*Prunus avium* L.	Chery	G		√*	√*	*							√*		
7.	*Prunus domestica* L.	Plum	G		√*	√*	*							√*		
8.	*Prunus persica* (L.) Batsch	Aru	G		√*	√*	*							√*		
9.	*Prunus prostrata* Labill.	Ralyo	G							√*	√*	√*				
10.	*Punica granatum* L.	Anar	G		√*	√*	*							√*		
11.	*Pyrus communis* L.	Nashpati	G		√*	√*	*							√*		
12.	*Pyrus malus* L.	Seb	G		√*	√*	*							√*		
13.	*Pyrus pashia* L.	Segal	G						√*	√*	√*					
14.	*Salix acmophylla* Boiss.	Jangli Beli	G		√*	√*							√*	√*		
C. Shrubs[a]																
1.	*Cotoneaster bacillaris* Wall. ex Lindl.	Ruins	G							√*	√*	√*				
2.	*Cotoneaster pruinosus* Klotz.	Roktali	G							√*	√*					

3.	*Hippophae rhamnoides* L.	Sarla, *Chharma*	G					√*	√*	√*	√*				
4.	*Indigofera heterantha* Wall. ex Brandis	Kali Kathi	G					√*	√*	√*	√*	√*			
5.	Lonicera hypoleuca Decne.	Kharmu	G					√*	√*	√*	√*				
6.	*Prinsepia utilis* Royle	Bhenkul	G								√*	√*	√*		
7.	*Rhamnus triqueter* (Wall. ex Roxb.) Lason	Chamso	G							√*	√*	√*	√*		
8.	*Ribes alpestre* Decne.	Pilikcha	G					√*	√*	√*	√*				
9.	*Ribes orientale* Desf.	-	G					√*	√*	√*	√*				
10.	*Rosa macrophylla* Lindl.	Kuja	G					√*	√*	√*	√*	√*			
11.	*Salix daphnoides* Vill.	Jangli Beli	G	√*	√*										√*
12.	*Syringa emodi* Wall. ex Royle	Pashu	G					√*	√*	√*	√*				

1 Wild variety
2 Sweet variety grafted on wild variety
√ = Lopping period
*= Seasonal utilization months
a= Most of shrubs are fodder of sheep and goat
G=green, D= dry

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